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# 1 Preliminaries

## Learning Outcomes

After completing this chapter, students should be able to do the following.

- Perform basic operations, including addition, scalar multiplication, and dot product, on vectors in  $\mathbb{R}^n$ .
- Perform basic operations, including addition and scalar multiplication, on geometric representations of vectors in  $\mathbb{R}^2$  and  $\mathbb{R}^3$ .
- Transition seamlessly between algebraic and geometric representations of vectors in  $\mathbb{R}^2$  or  $\mathbb{R}^3$ .
- Determine the angle between vectors and test for orthogonality.
- Project one vector onto another.
- Compute and interpret the cross product of two vectors in  $\mathbb{R}^3$ .
- Transition seamlessly between parametric and non-parametric forms of the equation of a line in  $\mathbb{R}^2$ .
- Transition seamlessly between parametric and vector forms of the equation of a line in  $\mathbb{R}^n$ .
- Determine the equation of a plane in  $\mathbb{R}^3$  meeting given characteristics.